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(54) Disk drive unit.

(57) A disk drive unit (10) comprises a disk drive housing (22), a circuit board (20) carrying drive electronics, and a relatively rigid chassis (26) for supporting the disk drive housing (22) and the circuit board (20). An interface connector is mounted generally at a rear end of the chassis (26) in a rearwardly facing orientation. A mounting bracket (36) securely mounts a power connector plug (12) onto the chassis in a rearwardly facing orientation and generally at the rear end of the chassis, whereby the disk drive unit can be slidably displaced in a rearward direction for slide fit coupling of the interface connector (14) and the power connector plug (12) with mating fittings (32, 28) of a computer system.

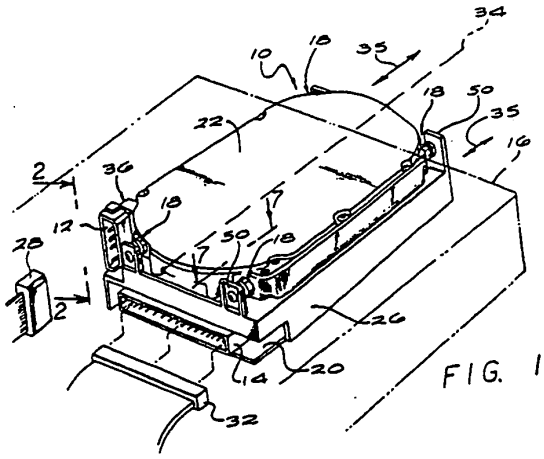

FIG. 1

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DISK DRIVE UNIT

This invention relates to disk drive units.

The present invention seeks to provide an improved mechanical mounting configuration for a power connector plug in a disk drive unit, improvements in shock mounts for isolating portions of the disk drive unit from undesired shock and vibration, and improvements in thermal isolation of a circuit board carrying drive electronics from other portions of the disk drive unit.

Disk drive units in general are known in the art for use in modern micro-computers such as personal and desk top computers and the like. In one popular form, such disk drive units comprise a so called Winchester disk drive unit having one or more rotatably driven memory storage disks mounted within a substantially sealed disk drive housing along with one or more related electro-magnetic heads for reading and writing data on appropriately prepared disk surfaces. A disk drive unit of this type, sometimes referred to as a "fixed" disk, is normally available as a compact package within the sealed disk drive housing mounted onto a rigid frame or chassis together with a circuit board carrying the necessary drive electronics for interfacing with other components of a computer system. In this regard, the disk drive unit requires a power connector plug for supplying electrical power to the drive electronics as well as to a drive motor for rotating the disks. In addition, the disk drive unit requires one or more interface connectors for coupling the drive electronics to the computer system, such as a main system controller which supplies appropriate commands to the disk drive unit for reading and/or writing data.

In the past, installation of a fixed disk drive unit into a modern micro-computer has been a relatively difficult task. More particularly, in a typical installation, it has been necessary to open the cabinet of the computer such as the housing of a main central processor unit to permit installation of the disk drive unit. The installation procedure has required careful and proper placement of the disk drive unit, together with correct coupling of the power connector plug and interface connector with mating fittings located within the processor unit housing. To avoid errors in installation and potential damage to fragile computer components, many individuals have preferred that installation of the disk drive unit is performed by a skilled technician.

In addition, disk drive units for modern micro-computers commonly include resilient shock mounts for supporting the sealed disk drive housing from the rigid chassis. Such shock mounts are intended to isolat the disks and associated h ads from undesired shocks or vibrations which could otherwise cause tracking errors in th course of reading and writing data. In the past, disk drive shock mounts have adhesive or the like between support blocks which are fastened in turn typically with screws to facing surfaces of the sealed disk drive housing and the chassis. However, these shock mounts are difficult to construct and install without applying a torque to the resilient buffer member, wherein such torque frequently causes the adhesive connection of the buffer member to fail.

Still further, in currently available disk drive units, problems have been encountered with respect to differential thermal expansion of the disk drive housing and the related circuit board during normal operation. That is, the sealed disk drive housing and the circuit board are constructed from different materials which experience different thermal growth when subjected to variations in temperature during normal operation of the disk drive unit. The circuit board is particularly subject to complex thermal growth characteristics due in part to localised hot spots attributable to heating of electronic components carried thereon. It is necessary to isolate the thermal size changes of the circuit board from the disk drive housing to prevent the imposition of structural stresses upon the housing, since such stresses potentially can cause minor shifts between the heads and the relative memory storage disks to result in read and or write errors.

There exists, therefore, a significant need for improvements in fixed disk drive units for computers, particularly with respect to simplifying disk drive unit installation into a central processor unit or the like of a computer system. Moreover, there exists a need for improvements in shock mounts for disk drive units, and in circuit board mounting arrangements for thermally isolating the board from remaining components of the disk drive unit.

A disk drive unit according to the present invention may be designed for relatively simple slide fit installation into a computer system from the front of a system cabinet, such as the cabinet of a main central processor unit or the like, without requiring the system cabinet to be opened or directly accessed. In addition, the disk drive unit may include improved shock mounts adapted for simplified assembly and installation. The disk drive unit further may include a relatively simple floating bushing arrangement for isolating thermal shift of a circuit board from other portions of the disk drive unit.

According to one aspect of the present invention, there is provided a disk drive unit comprising: a disk drive housing; a circuit board carrying drive

electronics; and a relatively rigid chassis for supporting said disk drive housing and said circuit board, said chassis having front and rear ends; characterised by the interface connector mounted generally at said rear end of said chassis in a rearwardly facing orientation; a power connector plug; and mounting means for securely mounting said power connector plug onto said chassis in a rearwardly facing orientation and generally at said rear end of the chassis, whereby the disk drive unit can be slidably displaced in a rearward direction for slide fit coupling of said interface connector and said power connector plug with mating fittings of a computer system.

According to another aspect of the present invention, there is provided a disk drive unit in combination with a computer system cabinet having a forwardly open slot therein for slide-in reception of the disk drive unit, and a power fitting and an interface fitting securely mounted generally at the rear of said cabinet slot in forward facing orientation, said disk drive unit comprising: a relatively rigid chassis having front and rear ends; a disk drive housing; a circuit board having drive electronics thereon; and means for supporting said disk drive housing and said circuit board from said chassis to define a generally compact package having an overall size and shape for sliding fit into said cabinet slot; characterised by an interface connector secured generally at a rear margin of said package in a position for mating coupling with said interface fitting when said package is slidably inserted into said cabinet slot; a power plug; and mounting means for mounting said power connector plug generally at a rear margin of said package in a position for mating coupling with said power fitting when said package is slidably inserted into said cabinet slot, said mounting means including means for isolating forces arising during coupling of said plug with said power fitting from said circuit board.

Said mounting means may comprise a mounting secured onto said chassis.

Said power connector plug may include at least one outwardly projecting tab, said mounting bracket being shaped for seated reception of said power connector plug and has a slot formed therein for receiving the or each said tab when said power connector plug is seated within said mounting bracket.

Said drive housing may define a back stop support surface for said power connector plug when the latter is mounted onto said chassis by said mounting bracket.

Said interface connector may be mounted onto a rear margin of said circuit board. In one embodiment said interface connector has a key thereon for mating reception into a mating notch formed in a rear margin of said circuit board.

Said power connector plug preferably is supported by said mounting means (36) at a position out of the plane of said circuit board.

The disk drive unit preferably includes a plurality of shock mounts for resiliently supporting said disk drive housing from said chassis, each of said shock mounts comprising generally cup-shaped outer and inner blocks for mounting respectively to said disk drive housing and said chassis, and a resilient cup- shaped buffer member nested between said outer and inner blocks and supported therebetween by nested reception of said buffer member into said outer block and by nested reception of said inner block into said buffer member.

Additionally or alternatively the disk drive unit may include circuit board mounting means for mounting said circuit board to said disk drive housing, said circuit board mounting means including a plurality of mounting screws passed through ports formed in said circuit board and fastened into bosses on said disk drive housing, at least some of said ports being over-sized and lined with a respective spacer bushing to permit at least some freedom of movement permitting the circuit board to float in its own plane to accommodate thermal size shift during normal operation of the disk drive unit. Each of said spacer bushings may include a radially enlarged flange at one end thereof interposed between the end of the associated boss on the disk drive housing and the circuit board, and an opposite axial end projecting through and at least slightly beyond the respective port.

According to a further aspect of the present invention, there is provided a shock mount for connecting a disk drive housing to a relatively rigid chassis, said shock mount being characterised by comprising: a generally cup-shaped outer block and including means for connection to one of said disk drive housing and said chassis; a generally cup-shaped resilient buffer member shaped for nested reception into said outer block; and an inner block shaped for nesting reception into said buffer member and including means for connection to the other of said disk drive housing and said chassis, whereby said resilient buffer member provides a shock and vibration damping buffer between said outer and inner blocks.

According to yet another aspect of the present invention, there is provided a mounting arrangement for mounting a circuit board from a disk drive housing characterised by comprising a plurality of ports formed in said circuit board; a plurality of fastener receiving boss members on said disk drive housing; a plurality of fasteners passed respectively through said ports into said boss member, at least some of said ports in said circuit board being over-sized to permit lateral shift of the circuit board

generally in the plane of the circuit board relative to said disk drive housing; and a plurality of spacer bushings seated within said over-sized ports for passage therethrough of the associated fasteners, said spacer bushings providing means for spacing said boss members and said fasteners from said circuit board.

The invention is illustrated, merely by way of example, in the accompanying drawings, in which:-

Figure 1 is a perspective view illustrating a disk drive unit according to the present invention;

Figure 2 is an enlarged fragmented perspective view illustrating a power connector plug mounting arrangement for the disk drive unit of Figure 1;

Figure 3 is a fragmented and partially exploded side elevation view of a portion of the disk drive unit, taken generally on the line 3 - 3 of Figure 2;

Figure 4 is a fragmented and partially exploded top plan view taken generally on the line 4 - 4 of Figure 3;

Figure 5 is an exploded perspective view illustrating further construction details of the power connector plug mounting arrangement;

Figure 6 is a rear elevational view taken generally on the line 6 - 6 of Figure 5;

Figure 7 is an enlarged fragmented top plan view illustrating a shock mount, taken generally on the line 7 - 7 of Figure 1;

Figure 8 is a fragmented vertical sectional view taken generally on the line 8 - 8 of Figure 7;

Figure 9 is an exploded perspective view illustrating assembly of components forming the shock mount;

Figure 10 is a fragmented bottom plan view of the disk drive unit of Figure 1;

Figure 11 is an enlarged fragmented vertical sectional view illustrating a floating spacer bushing, taken generally on the line 11 - 11 of Figure 10; and

Figure 12 is a perspective view of the floating spacer bushing.

As shown in the drawings, a disk drive unit 10 according to the present invention is provided for use in a computer system, such as in a modern micro-computer or the like. The disk drive unit 10 includes a mounting arrangement for a power connector plug 12 in association with a related interface connector 14 to permit simple slide fit installation of the disk drive unit 10 into an appropriate cabinet 16, shown in dotted lines in Figure 1, of a computer system. In addition, the disk drive unit 10 includes a shock mount 18 adapted for facilitated assembly and installation. The disk drive unit also includes an improved mounting arrangement for a circuit board 20 in a manner isolating thermal shift of the circuit board from a disk driv housing 22.

In general terms, the disk drive unit 10 comprises a Winchester or "fixed" disk drive of the type known for use in modern micro-computers, such as personal or desk top computers and the like. More specifically, the disk drive unit 10 includes a substantially sealed disk drive housing 22 within which is mounted one or more memory storage disks. These disks are rotatably driven by a small spindle motor in operative relation with associated electro-magnetic heads for reading and writing data on the surfaces of the disks. The disk drive housing 22 is carried by a relatively rigid frame or chassis 26, with the resultant package in turn supporting the circuit board 20 which carries the necessary drive electronics. The power connector plug 12 is adapted for coupling to a mating power fitting 28, and the interface connector 14 on the circuit board 20 is adapted for coupling to a mating surface fitting 32. Both the power and interface fittings 28, 32 are provided within the cabinet 16 of the computer system, such as within the main central processor unit of the computer system. As is known in the art, the power connector plug 12 couples electric power to the spindle motor and disk drive electronics, whereas the interface connector 14 couples the drive electronics to the computer system for operation of the disk drive unit as a component thereof. Importantly, the described components within the sealed disk drive housing may assume any construction known in the art.

As shown in detail in Figures 1 to 6, the power connector plug 12 and the interface connector 14 are mounted on a rear margin of the disk drive unit 10. More particularly, the interface connector 14 may be provided in one of several known standard types available in the computer industry, such as those interface connectors referred to as ST-506, SCSI, or ESDI, with the particular type selected being normally dependent upon computer system design performance. Moreover, in some designs, more than one interface connector 14 will be required. As shown best in Figures 1 and 2, the interface connector 14 is conventionally mounted at the rear margin of the circuit board 20 in a rearward facing position. In this orientation, the interface connector 14 is adapted for sliding movement along a fore-aft axis 34 in the direction of arrows 35 (Figure 1) for coupling with the mating interface fitting 32 within the computer system cabinet 16. A key 24 (Figure 10) may be provided on the underside of the interface connector 14 for registry with a notch 25 at the rear margin of the circuit board 20, thereby ensuring proper alignment of the interface connector 14 on the board.

The power connector plug 12 is also mounted at the rear margin of the disk drive unit 10 in a rearward facing position. However, as viewed in

Figures 1 and 2, the power connector plug 12 is positioned out of the plane of the interface connector 14, thereby permitting the interface connector 14 to occupy substantially the entire width of the disk drive unit. Moreover, the power connector plug 12 is securely anchored to the rigid chassis 26 in an orientation for sliding coupling with the mating power fitting 28 when the disk drive unit is slidably moved along the fore-aft axis 34. Accordingly, when the power and interface fittings 28, 32 are fixedly mounted within the cabinet 16 in forward facing orientations, the entire disk drive unit 10 can be installed quickly and easily from the front of the cabinet 16 by simply sliding the disk drive unit through an appropriate slot in the cabinet into coupled relation with the fittings 28, 32. Opening of the cabinet 16 for disk drive installation purposes is thus avoided.

A support bracket 36 is provided to mount the power connector plug 12 in a secure manner capable of withstanding the typical substantial reaction forces created as the plug 12 is engaged with the power fitting 28. More particularly, with reference to Figures 2 to 6, the support bracket 36 includes a side wing 38 adapted for simple securement to the disk drive housing 22 by means of a screw 40 (Figure 5) or the like. The side wing 38 is joined to a pair of up-standing bracket plates 41, 42 separated from each other by upper and lower slots 44. Upper and lower tabs 46 on the typically plastics moulded connector plug 12 are received through the slots 44, whereby forwardly directed forces created by engagement of the plug 12 with the fitting 28 are transferred through the plug 12 and its tabs 46 to the bracket plate 41. In the event that the bracket plate 41 is nevertheless deflected forwardly by these reaction forces, a rearwardly presented back stop surface 48 defined by a forwardly relieved portion of the disk drive housing 22 provides positive structural support for the plug 12. Importantly, the forces of engagement of the power connector plug 12 are, with this arrangement, isolated from the relatively fragile circuit board 20.

A plurality of the improved shock mounts 18 are provided for resiliently supporting the disk drive housing relative to the rigid chassis 26. In a preferred form, four of these shock mounts 18 are provided respectively at each of the four corners of the disk drive housing (Figure 1) for supporting the housing 22 with respect to adjacent up-standing support plates 50 on the chassis 26. These shock mounts 18 are designed to have a simplified construction for facilitating assembly and ease of mounting of the disk drive housing 22.

More particularly, as viewed in more detail in Figures 7 to 9, each shock mount 18 comprises an outer cup block 52 formed from a suitable rigid material such as metal and defining an open-ended cup having a non-circular exterior geometry such as a hexagonal shape for engagement with a wrench. A threaded shaft 53 projects co-axially from the closed end of the cup for threaded connection into a bore 54 (Figure 8) in the disk drive housing. A resilient, cup-shaped buffer member 56 is sized and shaped to nest within the outer cup block 52. An inner cup block 58 is sized and shaped for nesting in turn within the buffer member 56, wherein the inner block 58 includes an outwardly presented bore 59 for threaded reception of a screw 60 or the like provided to fasten the inner cup block 58 to the adjacent support plate 50. With this construction, the use of adhesive material for joining structures to the buffer member 56 is avoided and the shock mount components may be rotated relative to each other, such as during normal installation of the disk drive housing, without concern for the shock mount 18 becoming dis-assembled. Any suitable buffer member material may be used, such as DELRIN (trade mark), to provide the selected cushion characteristics for isolating the disk drive housing from external shocks and vibrations.

Figures 10 to 12 depict still another feature of the disk drive unit wherein the circuit board 20 is mounted to the underside of the disk drive housing 22 in a manner isolating the disk drive housing 22 from thermal shift encountered by the circuit board 20 during normal operation of the disk drive unit. More specifically, as viewed in Figure 10, a plurality of mounting screws are provided for fastening the circuit board to the disk drive housing, with three screws 61, 62, 63 being shown by way of example. At least some of these mounting screws are fastened into threaded bosses 64 formed in the disk drive housing 22 by passage through slightly over-sized ports 66 (Figure 11) in the circuit board. Each of these over-sized ports 66 is lined with a spaced bushing 68 adapted to undergo at least some positional floating in the plane of the circuit board 20 as the circuit board experiences thermal growth and contraction due to component heating during normal disk drive operation. As shown best in Figure 11, each spacer bushing 68 includes a radially enlarged upper flange 70 interposed between the lower end of the boss 64 and the upper face of the circuit board. In addition, the lower axial face of the spacer bushing 68 projects slightly beyond the underside face of the board such that the head of the screw 63 bears upon the bushing and not upon the relatively fragile board. Accordingly, while the mounting screws prevent separation of the circuit board from the disk drive housing, the over-sized ports 66 and spacer bushings 68 permit the board to undergo sufficient float in its plan to avoid transferring thermal shift stresses to the disk drive housing.

The mounting screw 61 at the front margin of the circuit board (Figure 10} is secured without float capability positively to anchor the circuit board. However, the other two mounting screws 62, 63 mounted to the board near opposite side margins and close to the rear margin are passed through the over-sized ports 66 and associated spacer bushings 68 which thus accommodate longitudinal thermal shift of the circuit board.

Claims

1. A disk drive unit (10) comprises: a disk drive housing (22); a circuit board (20) carrying drive electronics; and a relatively rigid chassis (26) for supporting said disk drive housing (22) and said circuit board (20), said chassis having front and rear ends; characterised by the interface connector (14) mounted generally at said rear end of said chassis (26) in a rearwardly facing orientation; a power connector plug (12); and mounting means (36) for securely mounting said power connector plug onto said chassis in a rearwardly facing orientation and generally at said rear end of the chassis, whereby the disk drive unit can be slidably displaced in a rearward direction for slide fit coupling of said interface connector (14) and said power connector plug (12) with mating fittings (32, 28) of a computer system.

2. A disk drive unit (10) in combination with a computer system cabinet (16) having a forwardly open slot therein for slide-in reception of the disk drive unit, and a power fitting (28) and an interface fitting (32) securely mounted generally at the rear of said cabinet slot in forward facing orientation, said disk drive unit comprising: a relatively rigid chassis (26) having front and rear ends; a disk drive housing (22); a circuit board (20) having drive electronics thereon; and means for supporting said disk drive housing (22) and said circuit board (20) from said chassis (26) to define a generally compact package having an overall size and shape for sliding fit into said cabinet slot; characterised by an interface connector (14) secured generally at a rear margin of said package in a position for mating coupling with said interface fitting (32) when said package is slidably inserted into said cabinet slot; a power plug (12); and mounting means (36) for mounting said power connector plug generally at a rear margin of said package in a position for mating coupling with said power fitting (28) when said package is slidably inserted into said cabinet slot, said mounting means including means for isolating forces arising during coupling of said plug with said power fitting from said circuit board.

3. A disk drive unit as claimed in claim 1 or 2 characterised in that said mounting means comprises a mounting (36) secured onto said chassis (26).

4. A disk drive unit as claimed in claim 3 characterised in that said power connector plug (12) includes at least one outwardly projecting tab (46), said mounting bracket being shaped for seated reception of said power connector plug and has a slot (44) formed therein for receiving the or each said tab when said power connector plug is seated within said mounting bracket (36).

5. A disk drive unit as claimed in claim 3 or 4 characterised in that said disk drive housing (22) defines a back stop support surface (48) for said power connector plug (12) when the latter is mounted onto said chassis by said mounting bracket (36).

6. A disk drive unit as claimed in any preceding claim characterised in that said interface connector (14) is mounted onto a rear margin of said circuit board (20).

7. A disk drive unit as claimed in claim 6 characterised in that said interface connector (14) has a key (24) thereon for mating reception into a mating notch (25) formed in a rear margin of said circuit board (20).

8. A disk drive unit as claimed in any preceding claim characterised in that said power plug connector (12) is supported by said mounting means (36) at a position out of the plane of said circuit board (20).

9. A disk drive unit as claimed in any preceding claim characterised by including a plurality of shock mounts (18) for resiliently supporting said disk drive housing (22) from said chassis (26), each of said shock mounts comprising generally cup-shaped outer and inner blocks (52, 58) for mounting respectively to said disk drive housing and said chassis, and a resilient cup-shaped buffer member (56) nested between said outer and inner blocks and supported therebetween by nested reception of said buffer member (56) into said outer block (52) and by nested reception of said inner block (58) into said buffer member (56).

10. A disk drive unit as claimed in any preceding claim characterised by including circuit board mounting means for mounting said circuit board (20) to said disk drive housing (22), said circuit board mounting means including a plurality of mounting screws (61, 62, 63) passed through ports (66) formed in said circuit board and fastened into bosses (64) on said disk drive housing (22), at least some of said ports (66) being over-sized and lined with a respective spacer bushing (68) to permit at least some freedom of movement permitting the

circuit board (20) to float in its own plane to accommodate thermal size shift during normal operation of the disk drive unit.

11. A disk drive unit as claimed in claim 10 characterised in that each of said spacer bushings (68) includes a radially enlarged flange (70) at one end thereof interposed between the end of th associated boss (64) on the disk drive housing (22) and the circuit board (20), and an opposite axial end projecting through and at least slightly beyond the respective port (66).

12. A shock mount for connecting a disk drive housing (22) to a relatively rigid chassis (26), said shock mount being characterised by comprising: a generally cup-shaped outer block (52) and including means (53) for connection to one of said disk drive housing (22) and said chassis (26); a generally cup-shaped resilient buffer member (56) shaped for nested reception into said outer block (52); and an inner block (58) shaped for nesting reception into said buffer member (56) and including means (59) for connection to the other of said disk drive housing (22) and said chassis (26), whereby said resillent buffer member (56) provides a shock and vibration damping buffer between said outer and inner blocks (52,58).

13. A mounting arrangement for mounting a circuit board (20) from a disk drive housing (22) characterised by comprising a plurality of ports (66) formed in said circuit board (20); a plurality of fastener receiving boss members (64) on said disk drive housing (22); a plurality of fasteners (61, 62, 63) passed respectively through said ports (66) into said boss member (64), at least some of said ports in said circuit board (20) being over-sized to permit lateral shift of the circuit board generally in the plane of the circuit board relative to said disk drive housing; and a plurality of spacer bushings (68) seated within said over-sized ports (66) for passage therethrough of the associated fasteners (61, 62, 63), said spacer bushings (68) providing means for spacing said boss members (64) and said fasteners (61, 62, 63) from said circuit board (20).

14. A mounting arrangement as claimed in claim 13 characterised in that each of said spacer bushings (68) includes a radially enlarged flange (70) at one end thereof interposed between the end of the associated boss (64) on the disk drive housing (22) and the circuit board (20), and an opposite axial end projecting through and at least slightly beyond the respective port (66).

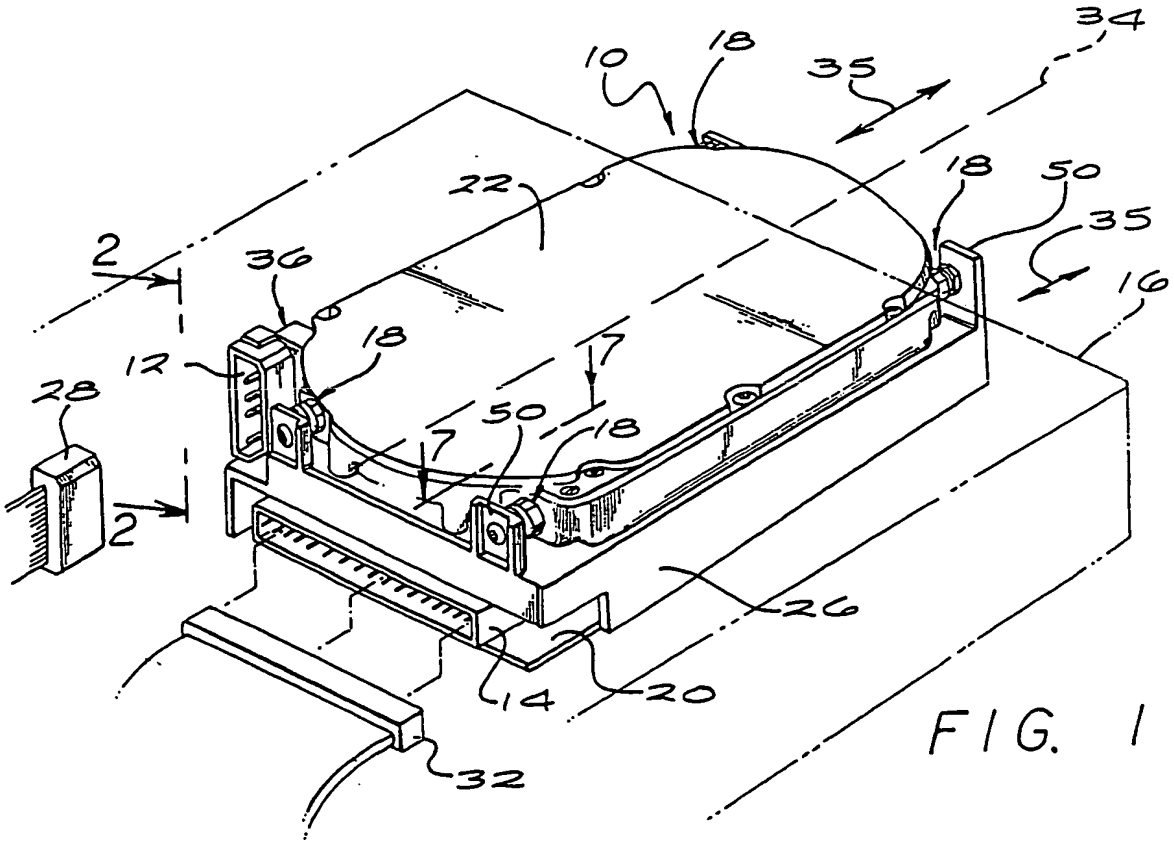
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FIG. 1

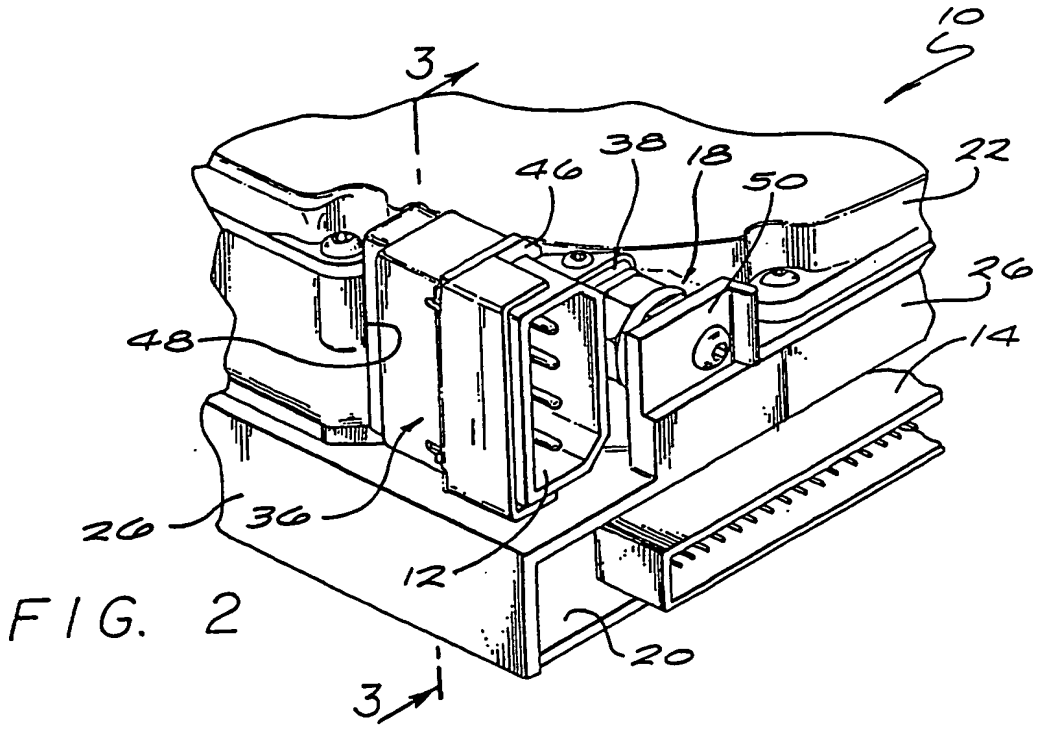
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FIG. 2

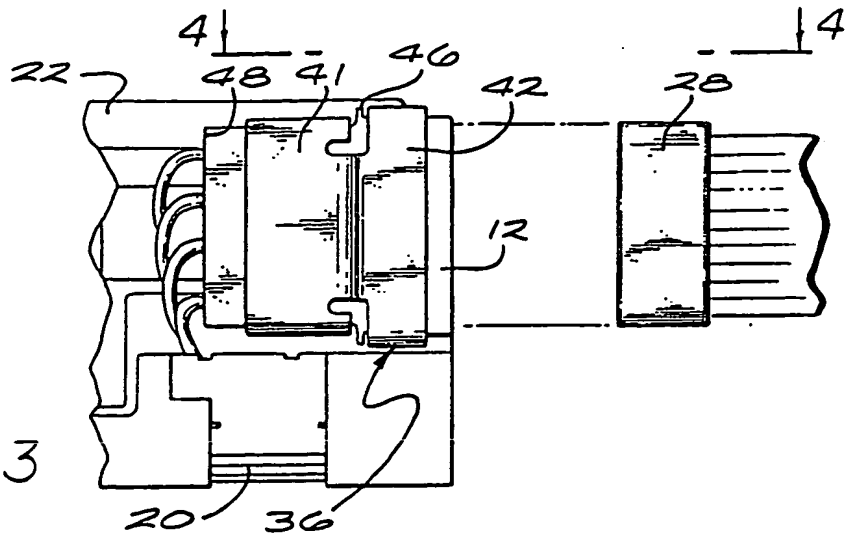

FIG. 3

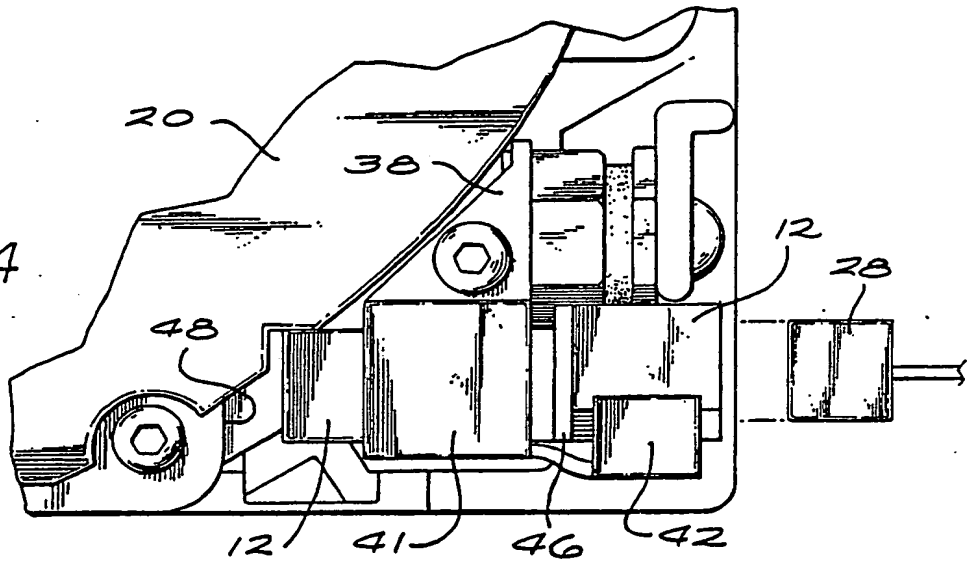

FIG. 4

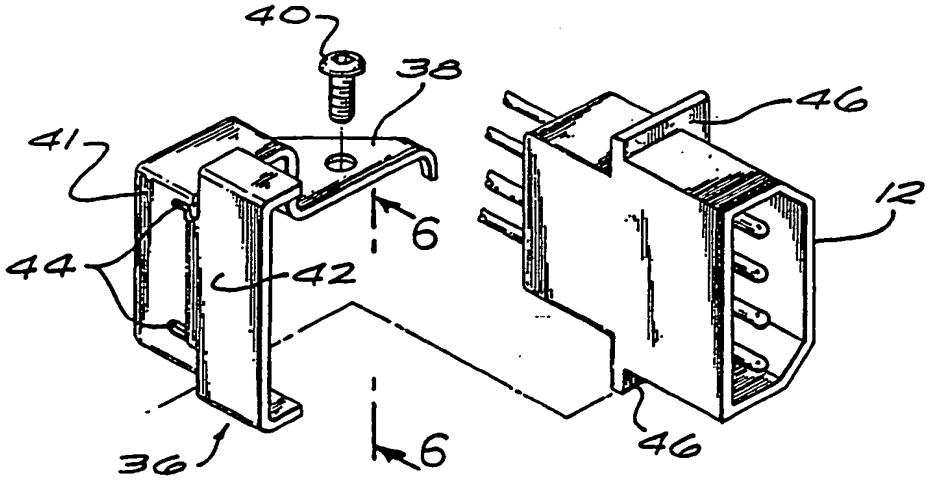

FIG. 5

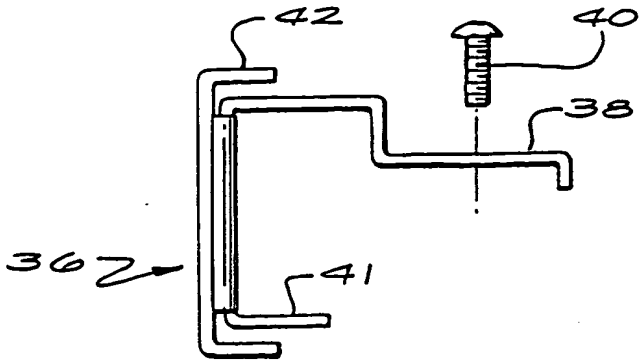

FIG. 6

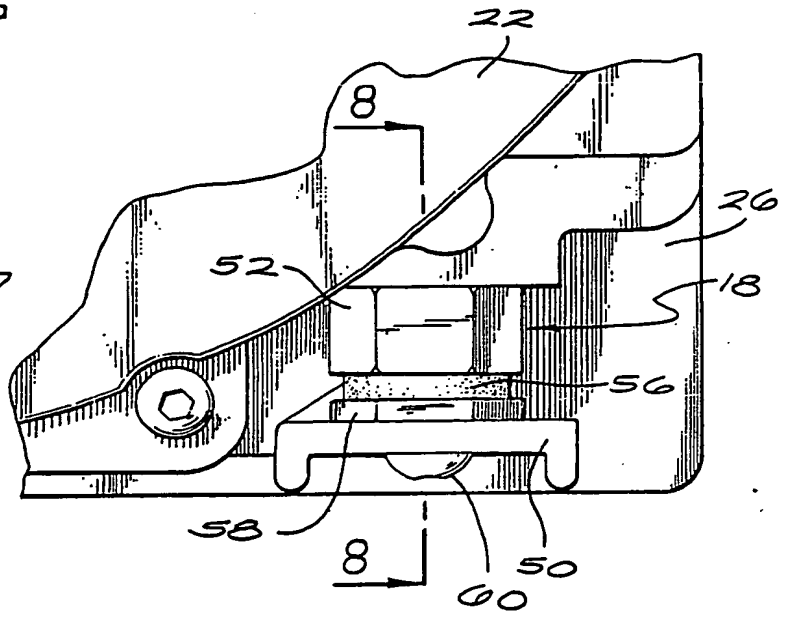

FIG. 7

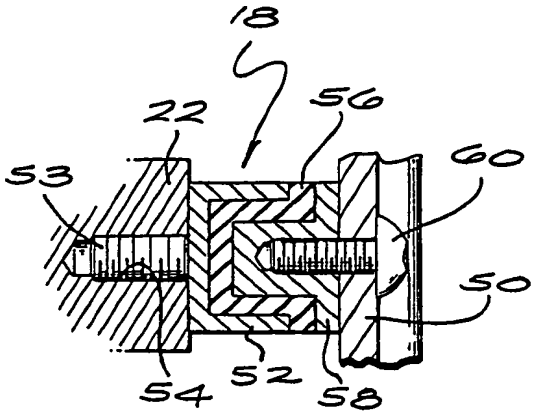

FIG. 8

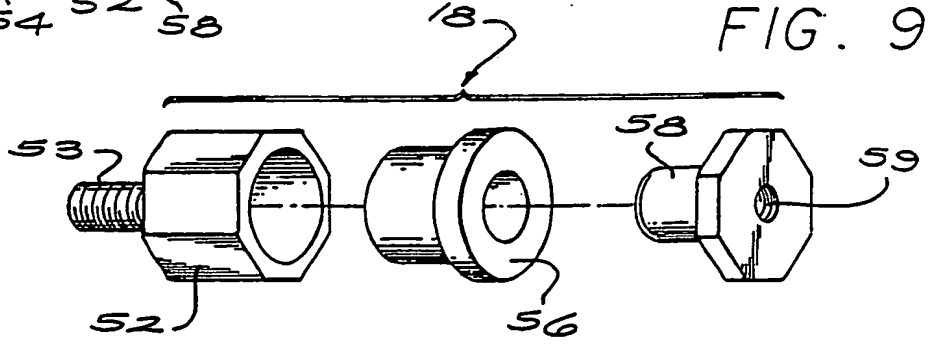

FIG. 9

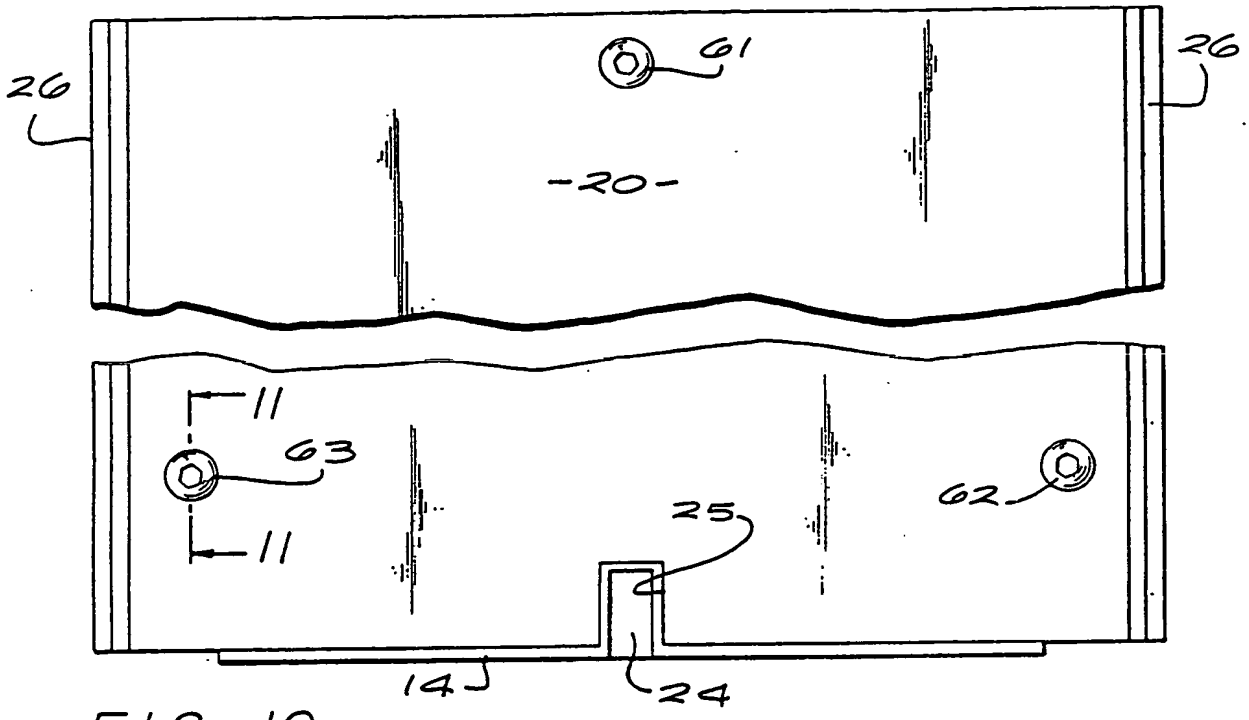

FIG. 10

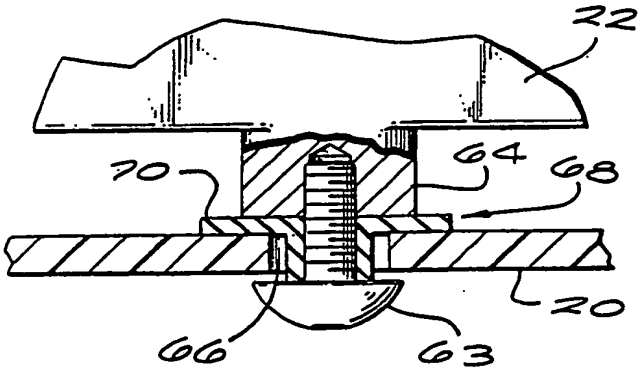

FIG. 11

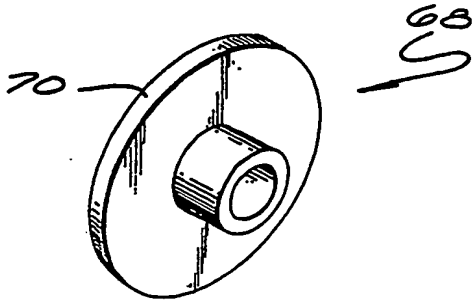

FIG. 12